PATENT ABSTRACTS OF JAPAN

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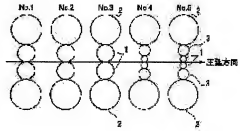
(54) ROLL FOR COLD ROLLING AND METHOD FOR MANUFACTURING HIGH HARDNESS HIGH CARBON THIN STEEL PLATE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a roll for cold rolling endurable for a long time use, having no unevenness on a roll surface, and to provide a method for manufacturing a high hardness high carbon thin steel plate capable of efficiently manufacturing a thin steel plate by cold-rolling the high hardness high carbon thin plate, restraining friction of the roll.
SOLUTION: The roll for cold rolling is characterized in that the roll has a rolling surface hardened through shot peening treatment, the hardness of the roll surface is Shore hardness 95 or more, and the center line average roughness Ra of the roll surface in the roll peripheral direction and in the axial direction is 0.3 to 0.5 μm.



CLAIMS

[Claim(s)]
[Claim 1]A roll for cold rolling, wherein it has the roll side which performs and stiffened a shot peening process, and hardness of this roll side is 95 or more in shore hardness and arithmetical-mean-deviation-of-profile Ra of a roll side of a roll hoop direction and shaft orientations is 0.3-0.5 micrometer.
[Claim 2]A manufacturing method of high hardness high carbon steel sheets installing a rolling stand which equipped a latter-part stand of a cold-rolling-mill sequence with a roll for cold rolling of the byway according to claim 1, and rolling a high hardness high carbon steel sheet in this cold-rolling-mill sequence.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the manufacturing method of the roll for cold rolling which performed the shot peening process to the roll surface, and the high hardness high carbon steel sheets using this roll.
[0002]
[Description of the Prior Art]For example, it is high hardness high carbon steel sheets of 0.65% or more of the amount of C of SK-5 grade, and in order for product sheet thickness to manufacture a steel plate of 0.6 mm or less with cold rolling, rolling which used the byway roll is needed for some work rolls. It is because rolling of hard material is possible for this since the byway roll can usually make rolling reduction per one roll high compared with a roll, and **** of a roll is small, so a thin board can usually be rolled with a roll if a byway roll is used even when a roll carries out flat and reaches a rolling limit.
[0003]When cold-rolling a high hardness high carbon steel sheet to sheet metal and a roll is usually used as a work roll, If between roll recombination and roll recombination shall be one set, a rolling amount will not be worn so much out even a set in about 600 t /, but when a byway roll is used as a work roll, since a byway roll is easily worn out, it can use only the rolling amount of about 200 t/set. Thus, it faces rolling a high hardness high carbon steel sheet to sheet metal using a byway roll, and the shortness of the life of this byway roll serves as a manufacturing neck. When using a byway roll for a work roll, an intermediate roll is needed, but since an intermediate roll is also worn out, the polish of a roll needs to carry out about a work roll and an intermediate roll, and requires cost.
[0004]So, to use a byway roll for a work roll in cold rolling of a high hardness high carbon steel sheet etc., it is necessary to make the life of a roll extend. The method of making it harden the surface of the roll for rolling to extend the life of a roll is effective, and the method of carrying out hardening treatment of the roll surface and the method of carrying out Cr plating of the roll surface are generally adopted as this.
[0005]
[Problem(s) to be Solved by the Invention]However, there is a problem which hardness unevenness generates in the conventional hardening treatment or the curing treatment of the roll by Cr plating method. That is, as a method of the hardness unevenness by heating in a heating furnace not being uniform occurring in hardening treatment, and performing Cr plating to a roll after roll polish in Cr plating method, For example, in using for the lengthwise direction in a plating solution tub the plating device which has arranged the roll, the unevenness of current may occur in a roll hoop direction, chrome plating thickness differs then in a roll hoop direction, and, as a result, the hardness unevenness of the roll hoop direction after chrome plating occurs. If hardness unevenness is in a roll hoop direction, a roll carries out eccentricity, a crosswise linear mark will occur in a steel sheet surface, or board thickness change will occur, and it will become a quality top problem.
[0006]Therefore, the purpose of this invention does not have hardness unevenness in a roll surface, and there is in providing the cold rolling roll which can be equal to prolonged use. There are other purposes of this invention in providing the method that a high hardness high carbon steel sheet can be cold-rolled efficiently, and sheet metal can be manufactured, controlling wear of a cold rolling roll as much as possible.
[0007]
[Means for Solving the Problem]A rolling method of a roll for cold rolling of this invention and high hardness high carbon steel sheets has the following features.
[0008](1) A roll for cold rolling, wherein it has the roll side which performs and stiffened a shot peening

process, and hardness of this roll side is 95 or more in shore hardness and arithmetical-mean-deviation-of-profile Ra of a roll side of a roll hoop direction and shaft orientations is 0.3-0.5 micrometer.
[0009](2) A manufacturing method of high hardness high carbon steel sheets installing a rolling stand provided with a roll for cold rolling of a byway of a statement in the above (1), and rolling a high hardness high carbon steel sheet in this cold-rolling-mill sequence to a latter-part stand of a cold-rolling-mill sequence.
[0010]
[Embodiment of the Invention]The roll for cold rolling of this invention has the roll side which performs and stiffened the shot peening process, hardness is 95 or more in shore hardness, and arithmetical-mean-deviation-of-profile Ra of the roll side of a roll hoop direction and shaft orientations of this roll side is 0.3-0.5 micrometer.
[0011]A shot peening process is processing which collides spherical particles with a roll surface and hardens a roll surface. In this invention, a shot peening process is performed in order to raise the hardness of a roll side and to obtain abrasion resistance.
[0012]The hardness of the roll side of this invention specifies or more as 95 by shore hardness, in order that it may obtain abrasion resistance, and it is because it becomes the shore hardness of the roll surface by the conventional roll surface curing method and sufficient abrasion resistance is not obtained by less than 95.
[0013]Although the conventional roll differed in arithmetical-mean-deviation-of-profile Ra of the roll surface in a roll hoop direction and shaft orientations, it has specified the both directions of a roll hoop direction and shaft orientations as 0.3-0.5 micrometer by both this inventions. It is because it will become easy to generate a slip if rolling load will become high too much if arithmetical-mean-deviation-of-profile Ra of a roll surface is too coarse exceeding 0.5 micrometer, and arithmetical-mean-deviation-of-profile Ra of granularity of a roll surface is too low at less than 0.3 micrometer.
[0014]Since quantity (rolling length etc.) rollable without slip generating is considered to be roll lives, a roll life can be raised without the direction which raises roll granularity slipping.
[0015]It is useful to use for rolling of a high hardness high carbon steel sheet the byway roll for cold rolling which has the composition mentioned above. Here, the desirable diameters of the byway roll for cold rolling are about 150 mm - 300 mm.
[0016]The collision speed of particles of the desirable conditions of the shot peening process for obtaining the hardness of the above-mentioned roll side and the granularity of a roll side is 100-200 m/second, using a spherical shot-grains child with a mean particle diameter of 30-60 micrometers.
[0017]Next, the manufacturing method of the high hardness high carbon steel sheets of this invention using the byway roll for cold rolling which has the composition mentioned above is explained.
[0018]In the manufacturing method of these high hardness high carbon steel sheets, the rolling stand which equipped the latter-part stand of the cold-rolling-mill sequence with the roll for cold rolling of the above-mentioned byway is installed, and a high hardness high carbon steel sheet is rolled in this cold-rolling-mill sequence.
[0019]Here, it is aimed at what has a chemical entity equivalent to the kind usually specified to JIS G 4401 carbon tool steel and JIS G 4051 carbon steels for machine structural use to high hardness high carbon steel sheets.
[0020]It is because a rolling draft cannot be taken by high load, either, if a steel plate work hardens, rolling load becomes high and a roll usually installs the rolling stand which equipped the latter-part stand of the cold-rolling-mill sequence with the roll for cold rolling of the above-mentioned byway so that it becomes the latter part. Therefore, the byway roll in which the bottom of high voltage is possible is installed in the latter part by low load.
[0021]The desirable conditions of the cold rolling method of high hardness high carbon steel sheets are as follows. There is no restriction in particular in the cold rolling mill which cold-rolls. However, the following is raised as a desirable gestalt of a cold rolling mill in case a steel plate rolls to steel sheets with high hardness.
[0022]More than one should be a rolling stand. They are four or more stands preferably. The work roll of two or more stands (two to 3 stand) by the side of the latter part which contains a last stand or this at least comprises a byway roll. The work roll of the other stand usually comprises a roll. Here, the desirable diameters of a byway roll are about 150 mm - 300 mm, and the diameters with a usually preferred roll are about 400 mm - 600 mm.
[0023]Although drawing 1 shows one embodiment of the cold rolling mill with which operation of this invention method is presented and the cold rolling mill of this embodiment is carrying out 5 stand owner of the rolling

stand which comprises four stage rolling machines (4Hi), Since a byway roll is generally used for the 4th and 5th stands at the time of rolling of a high hardness high carbon steel sheet, the 4th and 5th stands serve as six stage rolling machines (6Hi). At this time, as for the 4th and 5th stands, a work roll comprises a byway roll to the work roll diameter of the 1st - the 3rd stand being 550 phi, and a byway work roll diameter is 200 phi. In drawing 1, 1 shows a work roll, 2 shows the back up roll, and 3 shows an intermediate roll.

[0024]A byway roll is used for the work roll of the 4th and 5th above-mentioned stands for manufacturing the high hardness high carbon steel sheets which the amount of C cold-rolls at the bottom rate of high voltage from 0.65% or more of negative thickness [1.6 mm of] to 0.6 mm or less of board thickness generally.

[0025]Drawing 3 is a bluff which shows an example of the relation between a coefficient of friction and rolling length at the time of rolling in the conventional roll surface curing method by this invention method, and conventional hardening treatment and Cr plating method.

[0026]Here, a slip marginal coefficient of friction is defined as drawing 2. In drawing 2, in Tb, when front tension of a roll and P are used as a right-angled ingredient in the rolling direction of rolling power and alpha is used as an angle of friction, the slip marginal coefficient mu is expressed [Tf / the backward tension of a roll, and] with a lower type (1).

$$mu = (Tb-Tf) / 2 P+\sin (alpha/2) -- (1)$$

[0027]As shown in drawing 3, rolling length is extensible to a slip marginal coefficient of friction by rolling a high hardness high carbon steel sheet using the byway roll which performed the shot peening process of this invention method. The shot peening process whose collision speed of particles the mean particle diameter of particles is 60 micrometers, and is 150 m/second has been performed to the byway roll used by drawing 3. The place where only the rolling length of 50 km can carry out continuous rolling with a slip marginal coefficient of friction by this in the rolling method of the high hardness high carbon steel sheets using the byway roll which hardened the roll surface with the conventional roll surface curing method is expandable to the rolling length of even 75 km by this invention method. This is because the fall of granularity can be suppressed because the abrasion resistance of the roll surface improved. In drawing 3, by this invention method, it turns out that a coefficient of friction decreases more gently-sloping to a conventional method as rolling progresses. Thereby, a slip can be prevented.

[0028]

[Example]In the cold rolling mill shown in drawing 1, SK-5 material was rolled using the roll which performed the shot peening process to the surface of the byway roll.

[0029]Although the cold rolling mill shown in drawing 1 was carrying out 5 stand owner of the rolling stand which comprises four stage rolling machines (4Hi), when rolling SK-5 material, it rearranged and rolled the 4th and 5th stands to six stage rolling machines (6Hi). That is, the shot peening process whose collision speed of particles the mean particle diameter of particles is 60 micrometers, and is 150 m/second was performed to the work roll of the upper and lower sides with a diameter of 198 mm of the 4th and 5th stands. As a result, the upper work roll was set to Ra=0.38micrometer and HS=95, respectively, and, as for roll surface arithmetical-mean-deviation-of-profile Ra and the shore hardness HS, lower work rolls were set to Ra=0.41micrometer and HS=96, respectively.

[0030]When high hardness high carbon steel sheets were rolled using the above-mentioned roll, that whose rolling tonnage was 200 t in the conventional roll surface curing method was able to be expanded even to 300 t by this invention method. That whose rolling length was 50 km in the conventional roll surface curing method was able to be expanded even to 75 km by this invention method.

[0031]

[Effect of the Invention]As explained above, according to this invention, a roll life can be lengthened with the byway roll for cold rolling which performed the shot peening process, improvement in the material unit of a roll can plan, and the production of high hardness high carbon steel sheets can be continuously increased using said roll.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention]This invention relates to the manufacturing method of the roll for cold rolling which performed the shot peening process to the roll surface, and the high hardness high carbon steel sheets using this roll.

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PRIOR ART

[Description of the Prior Art]For example, it is high hardness high carbon steel sheets of 0.65% or more of the amount of C of SK-5 grade, and in order for product sheet thickness to manufacture a steel plate of 0.6 mm or less with cold rolling, rolling which used the byway roll is needed for some work rolls. It is because rolling of hard material is possible for this since the byway roll can usually make rolling reduction per one roll high compared with a roll, and **** of a roll is small, so a thin board can usually be rolled with a roll if a byway roll is used even when a roll carries out flat and reaches a rolling limit.
[0003]When cold-rolling a high hardness high carbon steel sheet to sheet metal and a roll is usually used as a work roll, If between roll recombination and roll recombination shall be one set, a rolling amount will not be worn so much out even a set in about 600 t /, but when a byway roll is used as a work roll, since a byway roll is easily worn out, it can use only the rolling amount of about 200 t/set. Thus, it faces rolling a high hardness high carbon steel sheet to sheet metal using a byway roll, and the shortness of the life of this byway roll serves as a manufacturing neck. When using a byway roll for a work roll, an intermediate roll is needed, but since an intermediate roll is also worn out, the polish of a roll needs to carry out about a work roll and an intermediate roll, and requires cost.
[0004]So, to use a byway roll for a work roll in cold rolling of a high hardness high carbon steel sheet etc., it is necessary to make the life of a roll extend. The method of making it harden the surface of the roll for rolling to extend the life of a roll is effective, and the method of carrying out hardening treatment of the roll surface and the method of carrying out Cr plating of the roll surface are generally adopted as this.

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EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, according to this invention, a roll life can be lengthened with the byway roll for cold rolling which performed the shot peening process, improvement in the material unit of a roll can plan, and the production of high hardness high carbon steel sheets can be continuously increased using said roll.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, there is a problem which hardness unevenness generates in the conventional hardening treatment or the curing treatment of the roll by Cr plating method. That is, as a method of the hardness unevenness by heating in a heating furnace not being uniform occurring in hardening treatment, and performing Cr plating to a roll after roll polish in Cr plating method, For example, in using for the lengthwise direction in a plating solution tub the plating device which has arranged the roll, the unevenness of current may occur in a roll hoop direction, chrome plating thickness differs then in a roll hoop direction, and, as a result, the hardness unevenness of the roll hoop direction after chrome plating occurs. If hardness unevenness is in a roll hoop direction, a roll carries out eccentricity, a crosswise linear mark will occur in a steel sheet surface, or board thickness change will occur, and it will become a quality top problem.
[0006]Therefore, the purpose of this invention does not have hardness unevenness in a roll surface, and there is in providing the cold rolling roll which can be equal to prolonged use. There are other purposes of this invention in providing the method that a high hardness high carbon steel sheet can be cold-rolled efficiently, and sheet metal can be manufactured, controlling wear of a cold rolling roll as much as possible.

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MEANS

[Means for Solving the Problem]A rolling method of a roll for cold rolling of this invention and high hardness high carbon steel sheets has the following features.
[0008](1) A roll for cold rolling, wherein it has the roll side which performs and stiffened a shot peening process, and hardness of this roll side is 95 or more in shore hardness and arithmetical-mean-deviation-of-profile Ra of a roll side of a roll hoop direction and shaft orientations is 0.3-0.5 micrometer.
[0009](2) A manufacturing method of high hardness high carbon steel sheets installing a rolling stand provided with a roll for cold rolling of a byway of a statement in the above (1), and rolling a high hardness high carbon steel sheet in this cold-rolling-mill sequence to a latter-part stand of a cold-rolling-mill sequence.
[0010]
[Embodiment of the Invention]The roll for cold rolling of this invention has the roll side which performs and stiffened the shot peening process, hardness is 95 or more in shore hardness, and arithmetical-mean-deviation-of-profile Ra of the roll side of a roll hoop direction and shaft orientations of this roll side is 0.3-0.5 micrometer.
[0011]A shot peening process is processing which collides spherical particles with a roll surface and hardens a roll surface. In this invention, a shot peening process is performed in order to raise the hardness of a roll side and to obtain abrasion resistance.
[0012]The hardness of the roll side of this invention specifies or more as 95 by shore hardness, in order that it may obtain abrasion resistance, and it is because it becomes the shore hardness of the roll surface by the conventional roll surface curing method and sufficient abrasion resistance is not obtained by less than 95.
[0013]Although the conventional roll differed in arithmetical-mean-deviation-of-profile Ra of the roll surface in a roll hoop direction and shaft orientations, it has specified the both directions of a roll hoop direction and shaft orientations as 0.3-0.5 micrometer by both this inventions. It is because it will become easy to generate a slip if rolling load will become high too much if arithmetical-mean-deviation-of-profile Ra of a roll surface is too coarse exceeding 0.5 micrometer, and arithmetical-mean-deviation-of-profile Ra of granularity of a roll surface is too low at less than 0.3 micrometer.
[0014]Since quantity (rolling length etc.) rollable without slip generating is considered to be roll lives, a roll life can be raised without the direction which raises roll granularity slipping.
[0015]It is useful to use for rolling of a high hardness high carbon steel sheet the byway roll for cold rolling which has the composition mentioned above. Here, the desirable diameters of the byway roll for cold rolling are about 150 mm - 300 mm.
[0016]The collision speed of particles of the desirable conditions of the shot peening process for obtaining the hardness of the above-mentioned roll side and the granularity of a roll side is 100-200 m/second, using a spherical shot-grains child with a mean particle diameter of 30-60 micrometers.
[0017]Next, the manufacturing method of the high hardness high carbon steel sheets of this invention using the byway roll for cold rolling which has the composition mentioned above is explained.
[0018]In the manufacturing method of these high hardness high carbon steel sheets, the rolling stand which equipped the latter-part stand of the cold-rolling-mill sequence with the roll for cold rolling of the above-mentioned byway is installed, and a high hardness high carbon steel sheet is rolled in this cold-rolling-mill sequence.
[0019]Here, it is aimed at what has a chemical entity equivalent to the kind usually specified to JIS G 4401 carbon tool steel and JIS G 4051 carbon steels for machine structural use to high hardness high carbon steel sheets.

[0020]It is because a rolling draft cannot be taken by high load, either, if a steel plate work hardens, rolling load becomes high and a roll usually installs the rolling stand which equipped the latter-part stand of the cold-rolling-mill sequence with the roll for cold rolling of the above-mentioned byway so that it becomes the latter part. Therefore, the byway roll in which the bottom of high voltage is possible is installed in the latter part by low load.
[0021]The desirable conditions of the cold rolling method of high hardness high carbon steel sheets are as follows. There is no restriction in particular in the cold rolling mill which cold-rolls. However, the following is raised as a desirable gestalt of a cold rolling mill in case a steel plate rolls to steel sheets with high hardness.
[0022]More than one should be a rolling stand. They are four or more stands preferably. The work roll of two or more stands (two to 3 stand) by the side of the latter part which contains a last stand or this at least comprises a byway roll. The work roll of the other stand usually comprises a roll. Here, the desirable diameters of a byway roll are about 150 mm - 300 mm, and the diameters with a usually preferred roll are about 400 mm - 600 mm.
[0023]Although drawing 1 shows one embodiment of the cold rolling mill with which operation of this invention method is presented and the cold rolling mill of this embodiment is carrying out 5 stand owner of the rolling stand which comprises four stage rolling machines (4Hi). Since a byway roll is generally used for the 4th and 5th stands at the time of rolling of a high hardness high carbon steel sheet, the 4th and 5th stands serve as six stage rolling machines (6Hi). At this time, as for the 4th and 5th stands, a work roll comprises a byway roll to the work roll diameter of the 1st - the 3rd stand being 550 phi, and a byway work roll diameter is 200 phi. In drawing 1, 1 shows a work roll, 2 shows the back up roll, and 3 shows an intermediate roll.
[0024]A byway roll is used for the work roll of the 4th and 5th above-mentioned stands for manufacturing the high hardness high carbon steel sheets which the amount of C cold-rolls at the bottom rate of high voltage from 0.65% or more of negative thickness [1.6 mm of] to 0.6 mm or less of board thickness generally.
[0025]Drawing 3 is a bluff which shows an example of the relation between a coefficient of friction and rolling length at the time of rolling in the conventional roll surface curing method by this invention method, and conventional hardening treatment and Cr plating method.
[0026]Here, a slip marginal coefficient of friction is defined as drawing 2. In drawing 2, in Tb, when front tension of a roll and P are used as a right-angled ingredient in the rolling direction of rolling power and alpha is used as an angle of friction, the slip marginal coefficient mu is expressed [Tf / the backward tension of a roll, and] with a lower type (1).

$$mu = (Tb-Tf) / 2 P+sin (alpha/2) --- (1)$$

[0027]As shown in drawing 3, rolling length is extensible to a slip marginal coefficient of friction by rolling a high hardness high carbon steel sheet using the byway roll which performed the shot peening process of this invention method. The shot peening process whose collision speed of particles the mean particle diameter of particles is 60 micrometers, and is 150 m/second has been performed to the byway roll used by drawing 3. The place where only the rolling length of 50 km can carry out continuous rolling with a slip marginal coefficient of friction by this in the rolling method of the high hardness high carbon steel sheets using the byway roll which hardened the roll surface with the conventional roll surface curing method is expandable to the rolling length of even 75 km by this invention method. This is because the fall of granularity can be suppressed because the abrasion resistance of the roll surface improved. In drawing 3, by this invention method, it turns out that a coefficient of friction decreases more gently-sloping to a conventional method as rolling progresses. Thereby, a slip can be prevented.

[Translation done.]

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EXAMPLE

[Example]In the cold rolling mill shown in drawing 1, SK-5 material was rolled using the roll which performed the shot peening process to the surface of the byway roll.
[0029]Although the cold rolling mill shown in drawing 1 was carrying out 5 stand owner of the rolling stand which comprises four stage rolling machines (4Hi), when rolling SK-5 material, it rearranged and rolled the 4th and 5th stands to six stage rolling machines (6Hi). That is, the shot peening process whose collision speed of particles the mean particle diameter of particles is 60 micrometers, and is 150 m/second was performed to the work roll of the upper and lower sides with a diameter of 198 mm of the 4th and 5th stands. As a result, the upper work roll was set to Ra=0.38micrometer and HS=95, respectively, and, as for roll surface arithmetical-mean-deviation-of-profile Ra and the shore hardness HS, lower work rolls were set to Ra=0.41micrometer and HS=96, respectively.
[0030]When high hardness high carbon steel sheets were rolled using the above-mentioned roll, that whose rolling tonnage was 200 t in the conventional roll surface curing method was able to be expanded even to 300 t by this invention method. That whose rolling length was 50 km in the conventional roll surface curing method was able to be expanded even to 75 km by this invention method.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

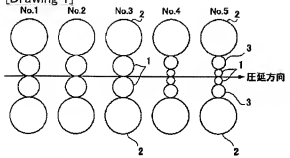
[Brief Description of the Drawings]
[Drawing 1]The front view showing one embodiment of the cold rolling mill with which operation of this invention method is presented
[Drawing 2]The explanatory view of the slip limit of a reduction roll
[Drawing 3]The bluff which shows an example of the relation between a coefficient of friction and rolling length at the time of rolling in this invention method and a conventional method
[Description of Notations]
1 Work roll
2 Back up roll
3 Intermediate roll

[Translation done.]

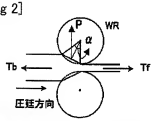
＊NOTICES＊

DRAWINGS

[Drawing 1]

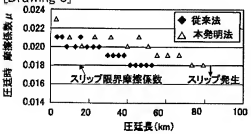


[Drawing 2]



スリップ限界摩擦係数 $\mu = \frac{Tb-Tf}{2P} + \sin\frac{\alpha}{2}$

[Drawing 3]



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